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VITAMINS AND FOOD DEFICIENCY DISEASES

By Dr. ALFRED C. REED
ASSISTANT CLINICAL PROFESSOR OF MEDICINE, STANFORD UNIVERSITY MEDICAL SCHOOL, SAN FRANCISCO

AMERICAN scientific men have been credited with lagging behind the progress shown in England and Europe in the domain of medicine. Surgery has come fully into its own, in the western hemisphere. But American medicine too often is held to be engaged solely in practising and teaching, and all too little in investigating. Its contributions to scientific knowledge are held to be meager and unimportant. Among many, one of the finest refutations of this mistaken notion is discovered in the impetus given by American scientists to our understanding of dietetics and food values, and the use of diet in the prevention and cure of disease. Strictly speaking, modern medicine has relatively little to do with drugs. Webster's definition of medicine is best, namely, the prevention, cure and alleviation of disease.

It has remained for American investigators to lead in showing how important is the rôle assumed by diet in the prevention, cure and alleviation of disease. The old dictum, "Feed a cold and starve a fever" has been reversed. Laboratory studies on the basis of exact measurements of energy requirements in the body under normal and pathologic conditions, have demonstrated that in the presence of fever, more energy is required, and that, if this additional energy is not furnished in an increased diet, it will be secured at the expense of serious inroads on the body reserves, and that such inroads result in definite symptoms and in abnormal physiologic processes which invariably tend to make the invading disease more dangerous.

Our appreciation of dietary requirements for health has advanced so that the term, a balanced diet, means considerably more than merely the provision of a sufficient energy supply. "Man shall not live by bread alone" is equally true of his physiologic mechanism. To-day a balanced diet implies of course that the body shall receive a sufficient quantity of energy from the food, that there shall be a proper number of calories of food energy per unit of body weight. It means a suitable distribution of this total caloric requirement between carbohydrate, fat and protein. It means also a proper mineral supply of inorganic salts. Water is a prime necessity for digestion, absorption and for cellular function. Four-fifths of the body weight is water and only one-tenth of the water in the body is found in the blood. Hence the necessity for sufficient water intake.

Since the epochal work of Emil Fischer, we now understand something still further of the mysteries of protein or nitrogenous metabolism. In food the protein molecule is extremely large and complex. In the process of digestion, through the action of digestive juices and enzymes, this molecule is broken down into relatively small units called amino acids. In digestion all forms of protein yield these ultimate amino acids or building stones. Less than a score of amino acids are known, but all proteins are composed of various groupings of two or more of these building stones. Thus it is easily understood that for repair of body tissue and for growth, there must be a correct selection of amino acids. No protein contains all the amino acids and many proteins lack certain amino acids which are absolutely essential for growth or for maintenance of body cells. Thus in practical dietetics it is necessary to do more than secure merely a certain total quantity of protein per day. That protein must be so selected, in quantity and quality, as to supply the required amino acids or ultimate building stones in correct variety and quantity. This explains why proteins of cereal or vegetable origin may not entirely substitute with safety for proteins of animal origin.

For some time it was supposed that nutrition consisted solely in the absorption and utilization by the body, either for energy or for tissue building, of food stuffs which, according to the preceding description, had been adequately prepared through the medium of digestion. These food stuffs seemed to have been placed on a level of chemical and mechanical exactitude by the wonderful development of physiological chemistry to which reference has been made, and by the classification of food into the great divisions of proteins (amino acids), fats, carbohydrates, minerals and water. The rapidly advancing and changing conception of food deficiency diseases has, however, led to and accompanied an extension of the classification of food elements to include certain as yet largely unknown substances, called vitamins, which have a definite controlling influence on nutrition, health and growth. Imbalance, or lack of some or all of this group, is believed to eventuate in physiological perversions which proceed to clinical disease. This conception parallels the idea of physiologic perversions due to deficiency in the earlier recognized food elements, as observed in starvation, or in the results of the body's inability to burn carbo-hydrate in diabetes.

In general food deficiency may be said to act in one of three ways to produce a departure from normal health and nutrition. It may result simply in mal-nutrition, or better, poor nutrition, from insufficient supply of the particular food elements lacking. This form of mal-nutrition is automatically more or less compensated for by increased utilization of other food elements. Such a compensatory use of other food elements occurs least in the case of protein insufficiency. Proteins may be spared in bodily nutrition by increased utilization of carbo-hydrate and fat, and thus the minimum necessary intake of nitrogenous food may be lowered, but no other food can actually and entirely replace the function of protein.

In the second place, a deficiency of some food element may cause a general disturbance of metabolism. This is illustrated by the condition of acid intoxication, or acidosis, which may result from a diet excessive in fat and deficient in carbo-hydrate, as seen, for instance in certain types of infantile acidosis, and in the dangerous and often fatal acidosis of diabetes. In the third place, a food deficiency may predispose to secondary factors which are directly responsible for disease. Thus a condition of under-nourishment from general deficiency or starvation, predisposes to infection. Again deficiency of a particular food element may result in a selective mal-nutrition of some organ or system of the body, as illustrated in the nerve degenerations of beriberi.

Thus it is evident that the problem of food deficiency is no simple one, but that it is complicated by selective results produced in the organism, by secondary factors which may become operative in the presence of the deficiency, and by obscure inter-relations and balances of nutritive equilibrium which easily may be disturbed by a variation in the component food elements. Here too must be considered the activity of various physiologic factors of safety in the animal body, which nature providently furnishes as additional safeguards against disruption of the delicate and sensitive adjustment necessary for health. Such a factor of safety is seen in the mechanism involved in maintaining proper alkalinity of the blood serum, thus preventing acidosis. Another illustration is the detoxifying function of the liver whereby various chemical poisons, if they happen to gain access to the blood stream, are automatically neutralized.

Given, then, a dietary constructed with due regard for water, mineral salts, carbo-hydrate, fat and protein building stones, one additional fact must yet be taken into account to secure a perfectly balanced food supply. This final factor has reference to the protein-like substances called vitamins, or accessory food substances. At present three types of these substances are recognized and a proper proportion of each is required to prevent serious derangement of the metabolism. It is not known whether these substances act in the body in a definite constructive fashion, entering themselves into the chemistry of metabolic processes, whether they act as catalytes, stimulating and originating changes in other substances but taking no chemical part themselves.

Two general lines of investigation are responsible for our present knowledge of vitamins. For a considerable time these two lines seemed contradictory, but they have gradually converged and afforded perspective and unity to our entire conception. The name "vitamin" was coined in 1911 by Casimir Funk for a substance occurring in rice polishings and yeast, which appeared to cure neuritis in birds and beriberi in man. This line of investigation was based on the earlier work of Eijkman in the Dutch East Indies, who, in 1897, had demonstrated a multiple neuritis in fowls fed on a polished rice diet and observed that this neuritis was curable by feeding rice polishings. In 1907, Fraser and Stanton, American workers in the Philippines, found that an alcoholic extract of rice polishings would cure experimental neuritis. Funk found the same to be true for yeast and from an imperfect knowledge of the chemistry of the substance, called it vitamin, an amino or basic nitrogenous body necessary for normal life. Thus the study of beriberi led to the name and conception of vitamins. Hopkins has suggested "accessory food substances" as a better term, and Graham Lusk "food hormones." Both suggestions have merit and the word vitamin has definite disadvantages, but priority, common usage and brevity have established vitamin as the term of choice and so it doubtless will remain.

The second line of investigation developed on the basis of nutritional studies by McCollum and his associates, by Osborne and Mendel, and others, which showed that various foods of approximately similar caloric value and total content of fat, carbo-hydrate and protein, exhibited an enormous variation in their ability to maintain life and promote growth. These experiments, in huge numbers, were carried out on animals and the results threw brilliant light on the problems of the food deficiency diseases as observed clinically in human-kind. It was found that certain food stuffs produced results in growth and nutrition out of all proportion to their quantitative or caloric value. Out of a great mass of carefully directed investigation, there crystallized in 1915 the recognition of two groups of vitamins, named by McCollum "fat soluble A" and "water soluble B." More recently evidence has accumulated in favor of a third group of vitamins called "water soluble C." This C group has to do with the prevention of scurvy. It is now possible by specialized chemical procedures to concentrate and isolate vitamins of these three groups.

The exact chemical nature of vitamins is unknown. The exact relation of vitamin deficiency is not in all cases clear. We can say, however, that growth, beriberi and xerophthalmia are directly related to A and B factors. Scurvy seems definitely connected with deficiency of the C vitamin. Evidence has accumulated that pellagra belongs with the vitamin deficiencies, and then follow a number of less clearly defined conditions, such as rickets, various forms of infantile and adult mal-nutrition, anemia and marasmus. These latter seem to be associated with an excess of carbo-hydrate in the diet, together with an insufficiency of mineral and animal constituents. While many cases of eczema now are known to be caused by a skin reaction to certain specific proteins of the food, still a large percentage of eczema depends on or is greatly influenced by an excess of fat or carbo-hydrate. The last statement applies also to acne or "pimples". A certain form of acid poisoning in babies is caused by excess fat in the diet. To a great degree dietary irregularities are responsible for the uric acid abnormalities of gout, and finally no small proportion of cases of constipation follow a diet lacking in bulk or in cellulose.

Again, as has been mentioned, symptoms which had been ascribed to certain diseases are found to be due in all probability to defective nutrition, again illustrating the relation of food deficiency to disease production. For example, diarrhea, delirium and the so-called typhoid state have been considered integral elements of the natural history of typhoid fever. However, since the introduction of the high calory diet in typhoid, these symptoms are usually mild or in abeyance. The inference is justifiable that these symptoms are due, not to the typhoid infection, but to a food deficiency resulting in mal-nutrition. This deficiency is doubtless qualitative as well as quantitative. It will be found probably that many symptoms of many diseases are not at all pathognomonic of those diseases, but are characteristic of and common to some form of unbalanced diet.

There is good reason to believe that the primary cause for the onset of many diseases will be found eventually to lie with a dietetic deficiency of some sort. In the case of amebic dysentery, for instance, McCarrison in Coonoor, India, found experimentally on monkeys that the disease appeared in the presence of a food deficiency where it did not develop when the monkeys were well nourished on a balanced diet. There is sound judgment in McCarrison's conclusion "emphasizing the importance in practice of a study of the dietary history of the case, believing as I now do that bacterial agencies are often but weeds which flourish in soil made ready for them by dietary defects, and believing also that in the fuller comprehension of the science of dietetics we shall understand more perfectly the beginning of disease and its therapy."

One further illustration of the vast importance of food deficiency in social, economic and health welfare, lies in the situation stressed by Dr. Mazyck P. Ravenel, president of the American Public Health Association. Dr. Ravenel advocates the cultivation of a wholesome fear of those diseases and infections which, while not apt to result in death, yet are attended by a high degree of social inefficiency and invalidism. Less emphasis on mortality and more emphasis on invalidism figures gives a better estimate of the real human seriousness of disease. Malaria destroyed Greece and Rome, and malaria has not a high death rate. Influenza struck the world with shocking severity, but it left no social scar on the race, no aftermath of invalidism and social inefficiency. Chronic exhaustive diseases like malaria, hookworm, tuberculosis and syphilis are, after all, the greatest scourges of mankind, and their social and economic cost is highest.

In two ways food deficiency is closely related to the considerations detailed in the last paragraph. In the first place, the greatest single predisposing factor to the development of the chronic exhaustive type of disease is food deficiency and mal-nutrition. Secondly, just as in the case of specific diseases, the more serious human losses are due to invalidism and social inefficiency, so in the realm of nutrition, after all is said, the loss from the definite specific deficiency diseases does not bulk so great as the huge loss from vague ill-health and more or less severe invalidism resulting from unbalanced or insufficient diet. In this connection are to be noted the nutritional dangers attendant on the increasing use of food substitutes. Examples of such substitutes are cotton seed oil for olive oil, or cod liver oil, margarines for butter, and the use of milk powders. Food substitutes are very important and may be very dangerous on a broad scale. The tendency in America is to excessive utilization of meats and sweets, with a subnormal employment of vegetables, fruits and dairy products. Such racial, local or individual aberrations of diet are vastly important and to an unbelievable degree are concerned with a sub-normal status socially, economically and in health. From such a sketchy survey it is evident that the science of dietetics promises to become ever more important in the treatment and prevention of disease, and as essential from the sanitary and public health point of view as for the individual man or woman.

We turn now to that smaller group of diseases which have been noted as having a direct relation to vitamin deficiency. While we can not state with absolute accuracy the specific element lacking in each case, we can assert with complete safety that they are due to an unbalanced or faulty diet, and that certain dietary procedures will serve adequately to prevent and to cure them.

Having clearly in mind what is meant by the term vitamin, and in spite of the disadvantages of the name, using it in a generic sense, it is next in order to consider why there should be clinical differences in disease types arising from a common etiology. Why should a vitamin deficiency in one case eventuate in beriberi, in another in pellagra and in a third in scurvy? While this question can not be fully answered at present, certain suggestive hypotheses may be predicated. As already explained, there is ground for the belief that vitamins are not unit substances, but represent a group chemically related and unstable, which may well have certain inter-relations necessary for their physiologic functioning. Thus absence of one type might be associated with a special clinical syndrome.

Recalling the three methods in which food deficiency may disturb the nutritional status, it is apparent that a vitamin deficiency may also produce differing clinical results by virtue of secondary factors which may become operative under varying conditions of climate, general condition of patient, concurrent infection, age—in short, that the effect of the vitamin deficiency may be influenced or even determined by all manner of extraneous circumstances, whose operation may conceivably be initiated or modified by the deficiency. It is not unlikely that the general type of caloric food supply used may be of importance, since we find for instance that beriberi is most common in rice eaters, and that pellagra is usually associated with maize.

Before discussing the common pathologic features of the deficiency diseases and methods of cure and prevention, it may be well to rehearse briefly the clinical picture of scurvy, beriberi and pellagra, with some suggestions of the experimental basis for believing them due to a food deficiency.

SCURVY

Armies and ships have suffered notoriously from scurvy. The name suggests the days of early exploration, long voyages and sailing ships. Whalers, fishermen, armies, sailors, explorers—all have feared and fought scurvy. As will be seen, the very circumstances which now are best explained as due to a food deficiency, were once considered conclusive proof of the disease being an infection and this view has prevailed to some extent, as in Russia, for example, almost to the present time. Its true nature was apprehended by the British much earlier as witnessed by the virtual disappearance of scurvy in the British navy since the regular rationing of lime juice began in 1795.

Scurvy is characterized by a pronounced inclination to hemorrhage, with soft, spongy bleeding gums, and hemorrhage under the skin and from mucus membranes. Certain bony changes follow and a condition of progressive weakness and anemia. In children, hemorrhages are more apt to occur under the periosteum causing what is often diagnosed by the mother as "rheumatism of the legs", and characteristic skeletal changes are seen. The condition rapidly improves upon the addition of anti-scorbutic articles to the diet. Fresh meat and vegetables, especially with limes, lemons, onions, etc., are quickly curative except in the extreme stage.

Comrie has recently detailed his experiences while on duty with British troops in northern Russia in 1919. Scurvy appeared on a large scale among prisoners and natives. After several months on a diet deficient in protein, vegetables and fresh foods, the disease appeared in wholesale fashion. Its effects were doubtless intensified by the crowded prisons, general poor surroundings, and the long Arctic night. A purpuric rash on the legs usually came first, accompanied by mental depression, loss of energy and weakness. Bleeding gums, swollen ankles, and hemmorrhages into muscles and joints rapidly followed. Pain was noticeably present. Recovery was rapid with correction of the diet alone, and in a month's time the victims showed few sequels of the disease. An effective anti-scorbutic was found in germinated peas or beans. Preserved lime juice was useless.

Another striking outbreak of scorbutic disease occurred as reported by Siccardi, in Italian troops serving at high altitudes in the Alps. In the summer of 1916 these troops suffered from a transient epidemic of a hemorrhagic form of scurvy. These hemorrhages were noted among those sick of other diseases as well as in men who had no other complaint. The disease was traced to an unbalanced diet, in the presence of cold, and ill ventilated under-ground quarters, and it was easily controlled by proper diet and rest.

Infantile scurvy is of surprising frequency especially in cities, where the widespread use of Pasteurized milk always brings danger of scurvy unless corrected by anti-scorbutics. Infantile scurvy is not common in the advanced stage characterized by very poor nutrition, "rheumatism of the legs," and bleeding spongy gums. But of surprising frequency, especially in cities, is a status of more or less indistinct symptoms associated with failure to gain weight and a tendency to hemorrhage, especially beneath the skin and mucus membranes, irritability and fretfulness, and sometimes femoral tenderness. Pateurized milk should be corrected by the addition to the diet of orange juice. It must be remembered that the advantage of Pasteurization vastly overbalances its tendency to produce scurvy, and that this tendency is easily controlled by a simple means.

In the group of deficiency diseases mid-way between scurvy and beriberi should be mentioned a peculiar syndrome called "ship beriberi." This affection differs from beriberi in its lack of involvement of the peripheral nervous system and is related to scurvy by its tendency to hemorrhage. The Newfoundland fishermen suffer from a similar condition in which a beriberi-like dropsy is associated with sore, bleeding gums. On the Labrador, the Esquimaux are frequently victims of scurvy and beriberi.

Dr. John M. Little, writing from Newfoundland, has described a deficiency disease related in causation and also doubtless in pathology, to this group. It is known among the natives as kallak. Commenting on the need for proper vitamin content in the diet, Dr. Little states that it is largely unknown as to where the Esquimaux get the necessary ingredients for a balanced diet outside of meat. The meat supply comes from seals, caribou, birds and fish. In good seasons berries too, are abundant, and when frozen, keep well. Dr. Little points out a possible source of carbo-hydrate supply when either civilized foods are not to be had, or when there is a failure of the berry crop. He says that the great feast of the Esquimaux consists of a thick soup made of the blood and stomach contents of the caribou. The caribou eats coarse vegetable matter such as lichens, moss, tree bark and small twigs, leaves and shoots, which are entirely unsuitable for the human stomach. The powerful digestive juices of the animal's stomach convert this coarse vegetable mass into forms which in turn can be acted upon by the more delicate digestive mechanism of man, and thus rendered assimilable. Thus is there secured the requisite vitamin supply from fresh vegetable sources.

Kallak appears on the Labrador in endemic form when there is a deficiency especially of seal meat and berries, resulting probably in a deficiency of the fat-soluble type of vitamins. It is in turn prevented and cured by an abundance of seal meat and berries. It shows itself in successive crops of a pustular erruption with intense itching. The disease tends to recovery as soon as a balanced diet is procured. Dr. Darling has described another variant of scurvy in the South African Rand, which has certain features approximating beriberi.

BERIBERI

Beriberi is a disease of antiquity known and described in ancient China, and recorded as having attacked a Roman Army in Arabia before the Christian era. It is pre-eminently a disease of the Orient and Pacific islands, although now widespread in Africa and South America, and not infrequently reported from other countries. It is not unknown in San Francisco and other parts of the United States. Its common association with a predominant rice diet does not always hold true. An instance of this is afforded by Draper, who in 1916 recounted nine early cases in a crew of fourteen men on a Norwegian bark touching at St. Helena. Here the victims had eaten sparingly of rice and had an abundance of fresh vegetables. An evidently beriberic diet was not demonstrable. Such instances lend credence to the parasitic theory of causation, held especially by certain English writers. For example, one of the most competent sanitarians in the Far East, Dr. Arthur Stanley, health officer of Shanghai, wrote in his 1914 report, "The cause of this disease (beriberi) remains under close observation, though up to the present wrapped in obscurity. The evidence preponderates in favor of the disease being an infectious one, having no direct relation to food but infective through body vermin." This view, however, is not tenable in relation to the American and Dutch results in the Philippines and East Indies.

Beriberi can now be classified accurately as a food deficiency disease caused by a lack of neuritis-preventing vitamin, water soluble B, in the food. Its occurrence in rice-eaters is associated with the use of polished rice, where the pericarp is removed from the grain. In this pericarp is the vitamin. The pericarp also contains an important fraction of phosphorus and the relative quantity of vitamin present can be measured by the quantity of phosphorus. Less than 0.4 per cent. of phosphorus pentoxide indicates a dangerous vitamin deficiency, if rice is the chief article of diet.

Beriberi is essentially a disease of the nervous system and shows itself in poly-neuritis, accompanied by an edema especially of the lower extremities and a weakened heart. This last is an important differential point, and the extreme tendency to cardiac failure is most serious. The disease may be acute and fatal within a few days or it may pursue a chronic course. The term beriberi, includes a large and more or less ill-defined group of diseases which have not yet been carefully separated. There are various types and all degrees of intensity, now one and now another symptom outstanding. Many forms are on the borderline of scurvy and may represent a combined deficiency. If the neuritis and nerve damage are sufficiently extensive, there may be a residual paralysis which long outlasts the original disease. Beriberi is often of importance in its incipient or larval form, because it predisposes to other diseases and in turn, larval beriberi may suddenly fulminate under the excitation of some other acute disorder. Thus beriberi is remarkably frequent in association with acute dysentery. It is interesting to note that beriberi is almost unique among tropical diseases in having no features of laboratory importance. The diagnosis rests solely on clinical data and the laboratory findings are entirely negative or normal.

Pellagra

Pellagra is an endemic disease of modern history. It is not definitely known to have been recognized earlier than the 18th century, when it was described in Italy and Spain as of rather wide distribution. From the first reports in Italy it has been ascribed to a maize dietary. It was early identified with "Alpine scurvy". The disease was recognized in Egypt in the first half of the nineteenth century, and since then in France and other parts of Europe. It was first described in the United States in 1907 but had undoubtedly existed there for an indefinite time preceding. It is estimated that there are 125,000 cases in the United States at present. According to Goldberger of the U. S. Public Health Service, who, with his associates has studied the disease exhaustively, it is one of the foremost causes of death in the southern states, in 1916 ranking fourth in Mississippi, third in Alabama, second in South Carolina. Not only this, but it is responsible for an unguessed total of sickness and physical inefficiency in addition. Its actual death rate is about 5 per cent. The relative infrequency of pellagra outside the endemic area in the United States will probably be found related to the dietary deficiency which we believe is its cause.

The incidence of pellagra has a close relationship to economic circumstances and living conditions. High food costs and hard times lead to poor sanitary and unhygienic living conditions, which as always, reach their climax where housing and sanitary knowledge are meager. This tends to enforce a dietary favorable to the development of pellagra especially in the south where corn, fat pork and certain types of vegetable food, are associated with a dearth of lean fresh meat, milk, eggs and green fresh vegetables. Following the economic conditions of 1914, the incidence of pellagra rose in 1915, again to decline as conditions improved a year later. Again in 1917 an increase was observed, due to like causes, and accurately foretold by the scientists of the Public Health Service.

The symptoms of pellagra are in three groups, appearing respectively in the skin, gastro-intestinal tract and nervous system. Pellagra, or "rough skin," derives its name from an early observation of the skin. Roughened, dry patches of erythema, often superficially similar to sunburn, and symmetrically located, are the characteristic lesions. These areas usually are on surfaces exposed to the sun, but not necessarily so. The second major group of symptoms arises from the gastro-intestinal tract, and includes various forms of indigestion, diarrhea, increased acidity of the stomach, and sore mouth. The mouth condition, in fact, is suggestive of sprue. Again, the tender bleeding gums are suspicious of scurvy, and represent a relationship to that disease as well as explaining the old name of "Alpine scurvy". The third major group of symptoms is referable to the nervous system. Fortunately not all cases of pellagra progress to insanity. But from the first a neurasthenic condition is present to which are added gradually various paresthesias, changes in reflexes, suicidal attempts, tremors, and, in the final stages, a confusional insanity.

All of these symptoms show a remarkable vernal periodicity, advancing in the springtime and receding toward autumn and winter. Not infrequently for several years the only symptoms noted will appear in the spring and not be related to each other by the patient. Fever is not present typically, except late in the disease and probably represents intercurrent infection due to the weakened organism. The outlook in pellagra is very dark unless the patient can be subjected to proper dietary treatment. Under such proper conditions, improvement and cure ensue even in advanced cases. Treatment cannot repair, of course, broken down tissues or remove organic changes in the brain and elsewhere.

OTHER DEFICIENCY DISEASES

As has been pointed out, there is a heterogeneous group of diseases and overlapping clinical conditions caused by deficiency of vitamin supply. One of the most definite of these is xerophthalmia, in which failing vision and blindness are produced by increasing opacity of the cornea. H. Gideon Wells has described the occurrence of xerophthalmia on a large scale among the famine sufferers of Roumania where it was promptly relieved by the administration of cod liver oil. The malady is evidently due to deficiency of the fat soluble A vitamin. Another and perhaps less clearly defined disorder is war edema, war dropsy, famine edema, or perhaps best, in the words of Wells, "nutritional dropsy". It was observed on a huge scale among prisoners of war in Germany and rather in those who were compelled to work while undernourished than among those who were merely underfed. Decreased protein and caloric intake are associated. It was frequently seen in conjunction with xerophthalmia. Another affection, similar in some points to beriberi and again to war edema, was reported from northern Africa during the Great War. This nutritional edema is probably identical with the dropsy occurring in infants fed for long periods on a highly carbonaceous diet.

It has been suggested that, succeeding an obvious state of malnutrition in infantile life, there may appear some disorder in later life with no apparent relation to the causal mal-nutrition. As an example of this, indications are cited that dental caries is produced by a deficiency in early life of a vitamin similar to fat soluble A. More recently most interesting experiments have been conducted by W. G. Karr, who finds a striking relation between the presence of water soluble B vitamin and appetite. This appetite-provoking vitamin is found in abundance in tomatoes and brewers' yeast.

Comparative Pathology

The beriberi-scurvy group of deficiency diseases exhibit a striking relationship in morbid anatomy. Darling working in the Canal Zone in 1915, graphically portrayed this relation in a chart of overlapping circles whose centers were arranged in a straight line. The chief pathologic findings were grouped in a series along the straight line, ranging from palsy, through dropsy, cardiac weakness and degeneration, nerve degenerations, spongy gums, hemorrhages, bone lesions, to the lesions at bone ends which are so notable a feature of rickets and often of scurvy. The overlapping circles each of which embraced several of the pathologic series, began with classical beriberi and ranged through ship beriberi, scurvy, guinea pig scurvy, and infant scurvy to rickets.

There is little doubt that beriberi is a disease group and not a fixed disease entity. The same is unquestionably true of scurvy and doubtless the other food deficiency diseases will eventually appear as types, varying with the relative imbalance of vitamins, and modified by other nutritional and environmental factors. As has been indicated, scurvy and beriberi have many points of pathologic similarity. Among these are especially to be noted the nerve degenerations and enlargement of the right heart. Pellagra differs somewhat in having a triple complex in pathology and symptoms, involving nervous system, gastro-intestinal tract and skin. It is of interest that scurvy often shows a reddened, roughened skin. The deficiency diseases are characteristically afebrile.

It is known that after eating buckwheat, many persons suffer from a severe dermatitis on exposing the skin to bright light. A similar explanation has been offered very plausibly for the rash in pellagra. It has been suggested, too, that the mental complex in pellagra is induced by bright light in a nervous system predisposed by a nutritional deficiency. The role of light, or actinic energy, in the causation and treatment of skin rashes, even in the acute infectious diseases such as smallpox, and scarlatina, is but poorly understood.

Darling found that in Rand scurvy, occurring with great frequency in South Africa and Rhodesia, there was a striking eccentric hypertrophy of the right heart, along with severe degenerations of the vagus nerve. Hess has noted the frequency of dilated right heart in infantile scurvy. There is often also associated a cardio-respiratory disturbance which still further illustrates the involvement of the nervous system. Such findings indicate a close relation between scurvy and the beriberi group. Darling calls attention to the contrast between beriberi as a neuro-cachexia, and rickets as an osteo-cachexia.

Vitamins and Diet

The fat soluble vitamins are found abundantly in butter, eggyolk and cod liver oil. The water soluble vitamins are found in yeast, and in many green vegetables and whole grains. There is reason for believing that vitamins can not be constructed either by animals or by plants, but that they are a product of bacterial action. Their presence is necessary for the growth of yeast and the rate of yeast growth has been used as a measure of the quantity of vitamins present in food substances. Vitamins are destroyed by heat, either excessive or of moderate intensity but long continued.

An interesting study of vitamins in bread was made by Voegtlin, Sullivan and Myers, of the U. S. Public Health Service, in connection with investigations on pellagra. They were impressed with the marked reduction in two decades of the vitamin content in the dietary of the population studied (Spartanburg county, South Carolina). They ascribed this reduction to three causes. First, reduction in usage of vitamin-rich foods such as fresh meats, eggs and milk, due to advancing cost. Second, increased use of highly milled cereals, made from wheat and corn, in which the vitamin-rich pericarp, husk and kernel are largely removed. Third, the increased use of baking soda in bread-making. The danger from soda lies in the fact that too often it is used to raise bread in place of yeast, and is not neutralized by acid as with sour milk. The soda apparently destroys the vitamin of the grain and this increases the deficiency of the excessively milled grain. The use of soda to soften beans and other foods in cookery, has an equally destructive result.

It is evident that the use of highly milled grains is to be condemned. The extensive utilization of whole grain products during the war was a most beneficial modification of our national dietary, and should be continued. Its benefits pertain to the stimulating effect on the teeth, the avoidance of a concentrated and costive diet, and the provision of more vitamins.

Under ordinary circumstances no particular attention is required to the practical details of securing sufficient vitamin content in the dietary of the average individual in this country. But in the endemic pellagra district, or where for any reason a varied supply of fresh foods is not to be had, the securing of the necessary vitamins becomes a matter of concern. Such a diet should include yeast bread made from the whole grain. If rice is used to any considerable extent, it should be undermilled, with a high phosphorus fraction. At least once weekly, legumes such as beans or peas should be served. Fresh fruit and vegetables should appear several times a week. Barley is especially desirable and should be added to all soups. Yellow or water ground cornmeal is preferable to the white variety. White potatoes and fresh meat also should be included at least weekly, and better once daily. So far as possible canned food should be discarded.

It may not be amiss to warn against commercial preparations of vitamins which are beginning to appear on the market. Under ordinary circumstances of life there is no need for such preparations. It is questionable whether any circumstances at present justify their use. Further than this, the chemical instability of vitamins makes it difficult to say under what conditions of preparation and preservation, their potency will be maintained. Then, too, since there is no approved method of standardization of vitamins, there is consequently no check on adulteration of commercial preparations. It seems probable that the appearance of vitamin preparations on the market, coupled with the present scientific and popular interest in the subject, will lead to an exuberant advertising campaign parallel to the exploitation of starch-free foods for diabetics. Among these latter, a small minority alone are found on analysis to be what they claim.

CONCLUSION

In summary, a new and important chapter is being written in our knowledge of nutrition, and to the classical requirements for a balanced dietary, has been added the requirement of a group of substances called vitamins. Vitamins are essential for growth, maintenance and reproduction of the human body, and lack of them leads to definite disease on a basis of mal-nutrition.